Remarks

In response to the Office action mailed April 16, 2009, Applicant respectfully requests reconsideration and allowance of the present application.

Section 132(a)

Applicant traverses the objection to "[t]he amendment filed 05/06/2006" under 35 U.S.C. § 132(a) for adding new matter. (04/16/09 Office Action at 2.) The Examiner asserts that certain portions of the specification were not included in the PCT filing. That is simply incorrect; they were so included. This may be seen by comparing the Image File Wrapper for this application (US Specification dated 05/06/2006) with that of Application No. PCT/US2004/036854 (PCT Specification dated 11/05/2004):

- Paragraphs [0024-0025] are included in the US Specification at page 4, lines 19-22 and in the PCT Specification also at page 4, lines 19-22;
- Figures 5A, 5B, 6A, and 6B were filed along with both the US Specification and the PCT Specification;
- the text starting from "6,346,198" through "argon gas flow" appears in the US Specification at page 8, line 27 to page 9, line 7, and in the PCT Specification also at page 8, line 27 to page 9, line 7;
- Paragraphs [0038-0040] are included in the US Specification at page 9, line 25 to page 10, line 8, and in the PCT Specification also at page 9, line 25 to page 10, line 8.

Because the portions of the specification and the drawings cited by the Examiner were included the PCT filing, those portions do not constitute new matter. The objection under § 132(a) should therefore be withdrawn.

Section 112

Applicant also traverses the rejection of claim 82 under 35 U.S.C. § 112 ¶ 1 as failing to satisfy the written-description requirement. Citing the present specification's description that "[t]he potential difference between the wafers 100 and 300 can be about 1.5 volts or can be higher, for example, about 20-50 volts" (Specification at ¶ [0036]), the Examiner maintains that the claimed range of 0.5 to 50 volts is contained neither in the specification nor in the PCT document. (04/16/09 Office Action at 3.) But this application's specification and the PCT filing both incorporate by reference the provisional application to which they claim priority, and the provisional application supports the claimed range. Also claim 82 is amended to recite "between about 0.5 and about 50 volts," which is consistent with the specification.

Specifically, as shown in the Image File Wrapper for Application No. 60/518,384, the provisional application discloses: "a voltage is applied to the doped wafer 300 and ramped from zero volts to a maximum of about 20-50 volts." (Provisional Specification at page 6, lines 23-24.) This description is sufficient to reasonably convey to a skilled artisan that as of this application's filing date Applicant had possession of the invention – including the claimed range of between about 0.5 and about 50 volts – recited in claim 82. No new matter is presented in amended claim 82, and therefore the rejection under § 112 ¶ 1 should be withdrawn.

Applicant also adds new claim 94, which recites a range of "between about 1.5 and about 50 volts" as described in the present specification (at ¶ [0036]). No new matter is presented in this claim, and thus claim 94 also meets the requirements of § 112 ¶ 1.

Section 102

Applicant also traverses the rejection of claims 74, 75, 79, and 80 under 35 U.S.C. § 102 as anticipated by Dai (U.S. Patent No. 6,401,526).

The present invention teaches producing multiple nanostructures using first and second substrates during microfabrication stages that grow nanostructures, which stages are typically carried out using Chemical Vapor Deposition (CVD). In contrast, the portions of Dai cited by the Examiner disclose using first and second substrates only after nanostructures have been grown.

Specifically, Dai begins by disclosing certain methods using CVD to grow carbon nanotubes. These are described in the two sections of the Detailed Description in Dai entitled "Nanotube Growth" and "Scaled-up Production of SWNT Probe Tips." (Dai at col. 3, line 64 to col. 6, line 67.) In particular, in the first section Dai discloses that "[t]he growth of AFM nanotube tips according to various embodiments of [Dai's] invention involves methane CVD synthesis of SWNTs [single-walled carbon nanotubes] using a newly developed liquid-phase catalyst precursor material." (Dai at col. 3, line 65 to col. 4, line 1.) Similarly, in the second section Dai discloses "growing properly oriented SWNTs." (Dai at col. 6, line 12.)

In a brief third section of the Detailed Description, entitled "Nanotube Shortening" (Dai at col. 7, lines 1-53), Dai describes shortening long, "as-grown" nanotubes:

> The SWNTs extending from silicon pyramid tips typically range 1-20 microns in length beyond the pyramid tip. The nanotubes are usually *shortened to ~30-100 nm* in order to obtain rigid AFM probe tips needed for imaging such as the one depicted in the inset of FIG. 1C. FIG. 5A shows the force calibration curve of *a long (~5 μm) and soft as-grown SWNT*. . . .
>
> According to a fourth embodiment of the present invention, shortening is achieved by way of an arc-discharge approach under an inert atmosphere. . . .
>
> In one example of the fourth embodiment, a stream of Ar is directed over the cantilever mounted in the AFM, the SWNT is brought into contact with a heavily doped silicon substrate and monitored by a cantilever amplitude vs. distance curve. A voltage is then applied between the tube and substrate

> and gradually increased until the loss of tube-substrate contact occurs as a result of nanotube shortening. This procedure allows the length of SWNTs to be reduced in steps of about 30 nm, providing an excellent control of the length of SWNT probes.
>
> (Dai at col. 7, lines 2-53 (emphasis added).)

Dai's shortening of already-grown nanotubes occurs post-CVD processing, and indeed the third section of Dai's Detailed Description mentions nothing about CVD.

Citing a portion of this third section of Dai in support, the Examiner asserts that Dai discloses "shortening of the nanotubes to a predetermined length (col 7, lines 22-53), performed by positioning a second substrate against the nanotube tips." (04/16/09 Office Action at 4.) But the use of first and second substrates in Dai is very different from that claimed in the present application's independent claim 74, which recites "positioning a first surface of a second substrate distal to the multiple tips" and "forming the multiple nanostructures between the respective apexes of the tips and the surface of the second substrate," thus indicating steps occurring during a nanotube-growth stage *before or without* any nanotube-shortening stage. Neither the portions of Dai cited by the Examiner nor anything else in Dai teaches the Applicant's claim 74.

Aside from the plain language of the claim itself, the difference between the positioning and forming steps of claim 74 and the portions of Dai cited by the Examiner is demonstrated by other claims of the present application. For example, dependent claim 80 recites "applying a voltage . . . to shorten the length of the respective carbon nanotubes" as an additional step to the steps recited in the method of claim 74. Similarly, dependent claims 81-84 each recite a step involving cleaving and/or shortening nanotubes as an additional step to the method of claim 74. This claim differentiation also makes clear that the present invention's first and second substrates are being used in a nanotube-growth stage.

Moreover, the present application's specification confirms that the first and second substrates in claim 74 are used during nanotube growth. Positioning of a second substrate is

described during the microfabrication process – CVD in the case of the discussed preferred embodiments – to grow nanotubes. (*See, e.g.*, Specification at ¶¶ [0033-0034].) The present application goes on to describe nanotube shortening as occurring later, after CVD processing and after the nanotubes have been grown. (*See, e.g.*, Specification at ¶ [0036].)

To summarize, while Dai describes using a second substrate during the post-CVD nanotube-shortening stage, in claim 74 the present invention instead claims particular steps – "positioning . . . a second substrate" and "forming the multiple nanostructures between the respective apexes of the tips and the surface of the second substrate" – that concern nanotube growth, not shortening. In addition, certain dependent claims recite an additional step concerning nanotube shortening, thus differentiating claim 74, which recites a method without limitation to such a shortening step. And using first and second substrates during the nanotube-growth stage is described clearly in the present application's specification. Thus, Dai does not anticipate independent claim 74 or dependent claims 75, 79, and 80. The § 102 rejection should therefore be withdrawn.

Section 103

Applicant also traverses the rejection of claims 76 and 77 under 35 U.S.C. § 103(a) as obvious in light of Dai as applied to claim 74. (*See* 04/16/09 Office Action at 4-5.) As discussed above, the Examiner's citations regarding Dai's disclosure of a second substrate concern the nanotube-shortening stage, which is not a limitation in independent claim 74. Therefore, Dai cannot render obvious dependent claims 76 and 77.

Applicant also traverses the rejection of claims 74-77, 80, 85, and 86 under 35 U.S.C. § 103(a) as obvious in light of Lee (U.S. Patent Appln. Publn. No. 2002/0046953), in view of Dai.

The Examiner asserts that "Lee teaches the formation of a substrate 57 (or 53) (Fig. 6, [0055], [0063]) including a plurality of nanotube growth catalysts placed opposite to a second substrate (55, Fig. 6)." (04/16/10 Office Action at 5.) But this misreads the cited portions of Lee, which describe components of a reaction chamber in a Plasma-Enhanced CVD system. (*See* Lee at ¶¶ [0064] & [0069].) (Though ostensibly not limited to PE-CVD, that is the only method described in connection with Lee's reaction chamber.)

Specifically, as the terms are used in claim 74, neither reference numeral 53 nor 57 in Lee indicates a "first substrate," nor does reference numeral 55 indicate a "second substrate"; indeed, in Lee certain substrates are denoted with yet another reference numeral:

> Referring now to FIG. 6a, the *substrates 31* with catalyst dots 33 are then placed into a *reaction chamber 51* for catalyst-induced growth of carbon nanostructures 35 on the catalyst dots 33. The reaction chamber 51 includes a *combination cathode and heater plate 53*, and an *anode plate 55*. A *rack 57* mounted on the combination cathode and heater plate 53 supports preferably multiple substrates 31.
>
> (Lee at ¶ [0063] (emphasis added).)

Thus, no ordinarily skilled artisan would consider comparable, on the one hand, the first substrate claimed in claim 74 and, on the other hand, components of Lee's reaction chamber 51 (combination cathode and heater plate 53 or rack 57). Similarly, no ordinarily skilled artisan would consider comparable, on the one hand, the second substrate claimed in claim 74 and, on the other hand, another component of Lee's reaction chamber 51 (anode plate 55). Assuming arguendo that Lee could be combined with Dai, independent claim 74 clearly distinguishes over the combination.

Even if somehow the cathode and heater plate 53 or rack 57 might be considered a first substrate 53/57, and the anode plate 55 might be considered a second substrate 55, one of ordinary skill in the art would readily appreciate additional clear distinctions between the present invention and Lee. The Examiner, while recognizing that Lee does not state so, asserts that "the growth of the nanotubes would be clearly limited by the distance between the

substrates 53/57 and 55." (04/16/09 Office Action at 5.) But that is incorrect. Skilled artisans would recognize that the distances between Lee's reaction-chamber elements 53/57 and 55 are on the order of centimeters. Such distances are orders of magnitude larger than the typical size of nanotubes grown using any methods, particularly nanotubes used in scanning probe microscopy, which are typically on the order of hundreds of nanometers. Simply put, a nanotube that is centimeters long is practically unusable in the field of scanning probe microscopy.

Moreover, with the claimed invention the length of nanotubes can be controlled based on the distance of the first and second substrates, but in Lee "[t]he length of the carbon nanostructures 35 can be controlled by controlling the duration of the PE-CVD process." (Lee at ¶ [0070].) Again, assuming for argument's sake that Lee and Dai could be combined, that combination teaches nothing like the invention claimed in claim 74.

Applicant also traverses the rejection of claims 78, 81, 82, and 87 under § 103(a) as obvious in light of Lee in view of Dai, and further in view of Lieber (U.S. Patent Appln. Publn. No. 2002/0122766), and the rejection of claims 82 and 83 under § 103(a) as obvious in light of Lee in view of Dai, and further in view of Mancevski (U.S. Patent No. 6,597,090). (04/16/09 Office Action at 8-10.) As demonstrated above, the combination of Lee and Dai does not approach teaching the invention claimed in independent claim 74, and thus even assuming a combination with Lieber or Mancevski is possible, claim 74 is patentably distinct over either combination. Dependent claims 78, 81-83, and 87 therefore also distinguish over the references.

In view of the foregoing, independent claim 74 and dependent claims 75-87 and 94 are nonobvious in view of the cited prior art, and therefore all the § 103(a) rejections should be withdrawn.

Given the discussion in these Remarks, other assertions and arguments made by the Examiner need not be addressed, although Applicant reserves the right to do so.

This application is believed to be in condition for allowance and a notice to that effect is respectfully solicited.

If any fee is required, please charge Deposit Account No. 50-0979.

Respectfully submitted,

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